Methods and apparatus for reshaping hollow members

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Abstract of **GB2224965**

A can reshaping apparatus includes a mould having two halves 18, 20 pivotally supported from a pivot post 12. A shuttle comprising a shaft 40 having upper and lower supports 48, 42 is slidable along the mould chamber axis to bring a can into and out of the chamber. When a can is brought into the chamber, the two mould halves 18, 20 are closed and this also imprisons the supports 48, 42 in the mould. A hydraulic clamp 54 acts to seal the flange of the can against a mould liner (26B, Fig. 6) of the mould.

A mandrel 52 upstanding from a base 10 substantially fills the can but leaves a small gap. Compressed air is fed through openings 56 in the mandrel 52 into the gap to cause the can to expand to conform to the profile of the mould liner. The air is pressurised totally outside the can, and after reshaping of the can some of the pressurised air is recovered while still under pressure, for use in pressurising a subsequent can. The apparatus may be an automated can reshaping apparatus

comprising eight can reshaping stations (4, Fig. 5) on a rotary turntable (2). A drive system of the rotary turntable is coupled to a piston (62, Fig. 8) supplying the pressurised air. The piston (62) moves in a cylinder (60) which is precharged with air from a source (68) of substantially constant pressure.

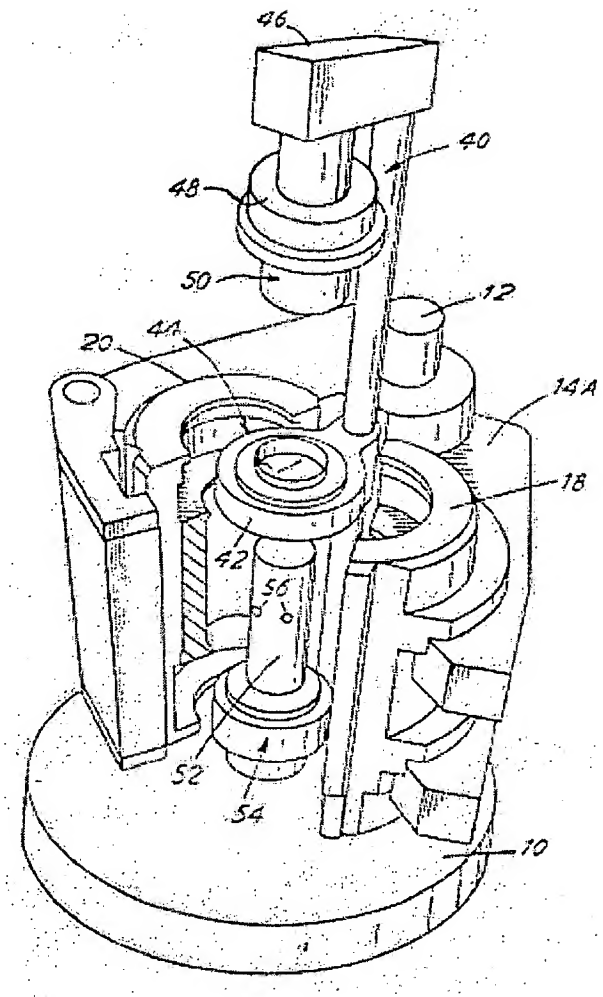

FIG.7

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(54) Methods and apparatus for reshaping hollow members

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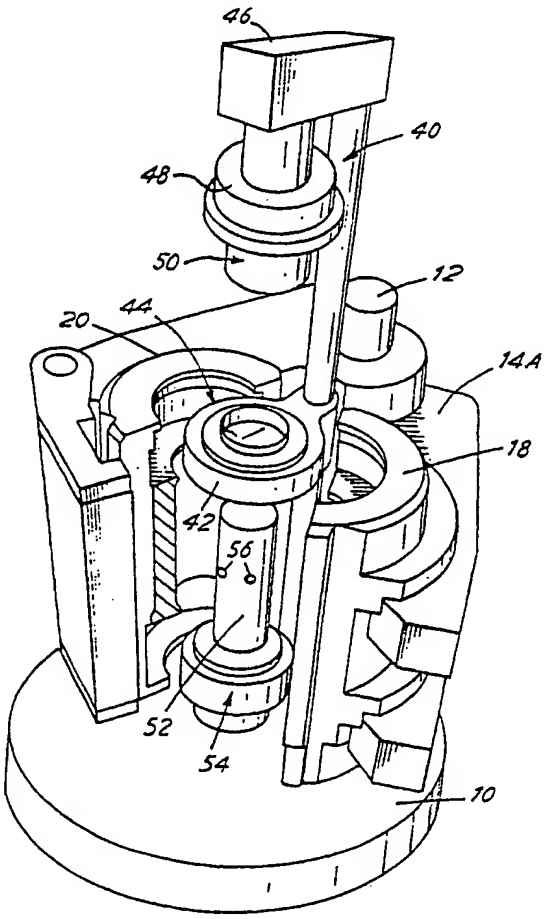

FIG.7

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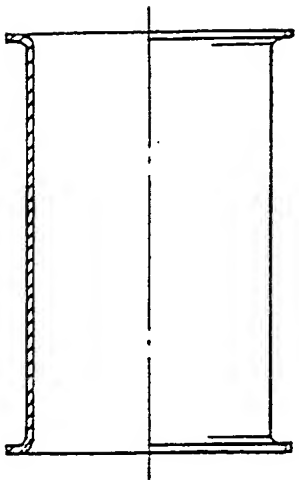

FIG. 1A

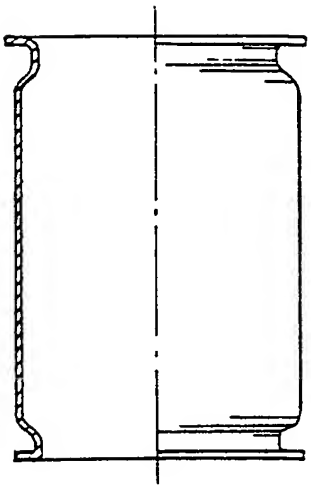

FIG. 1B

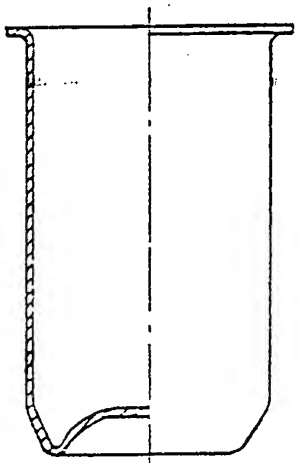

FIG. 2A

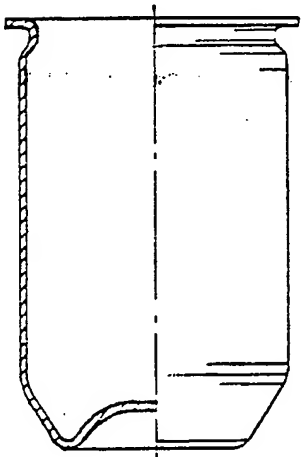

FIG. 2B

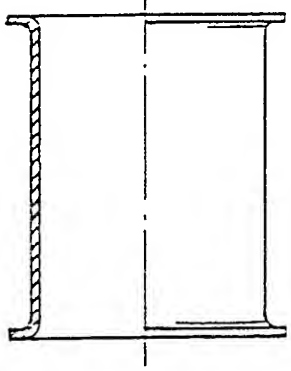

FIG. 3A

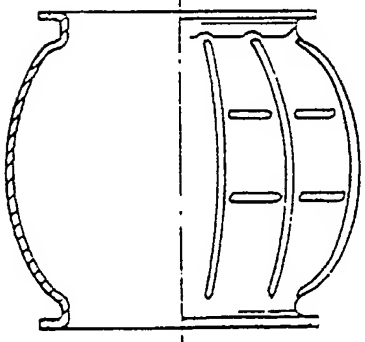

FIG. 3B

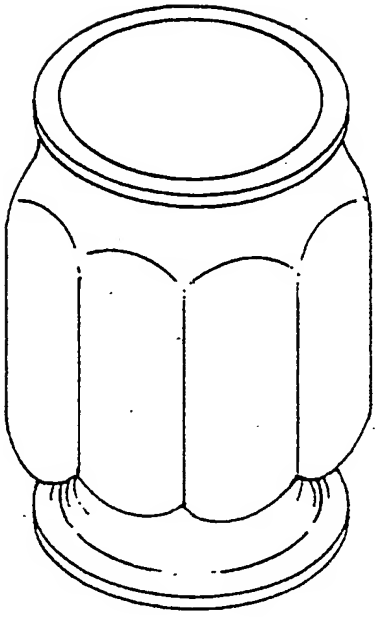

FIG.4

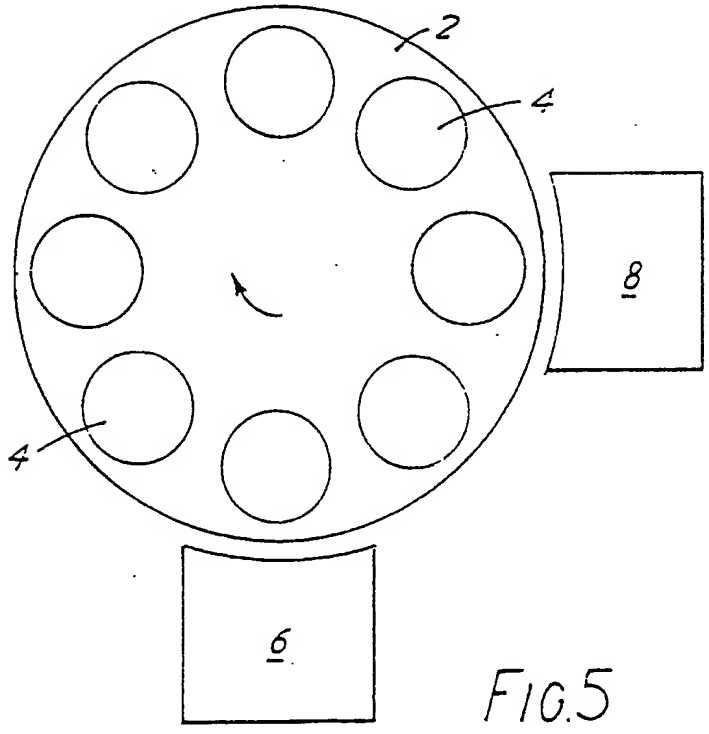

FIG.5

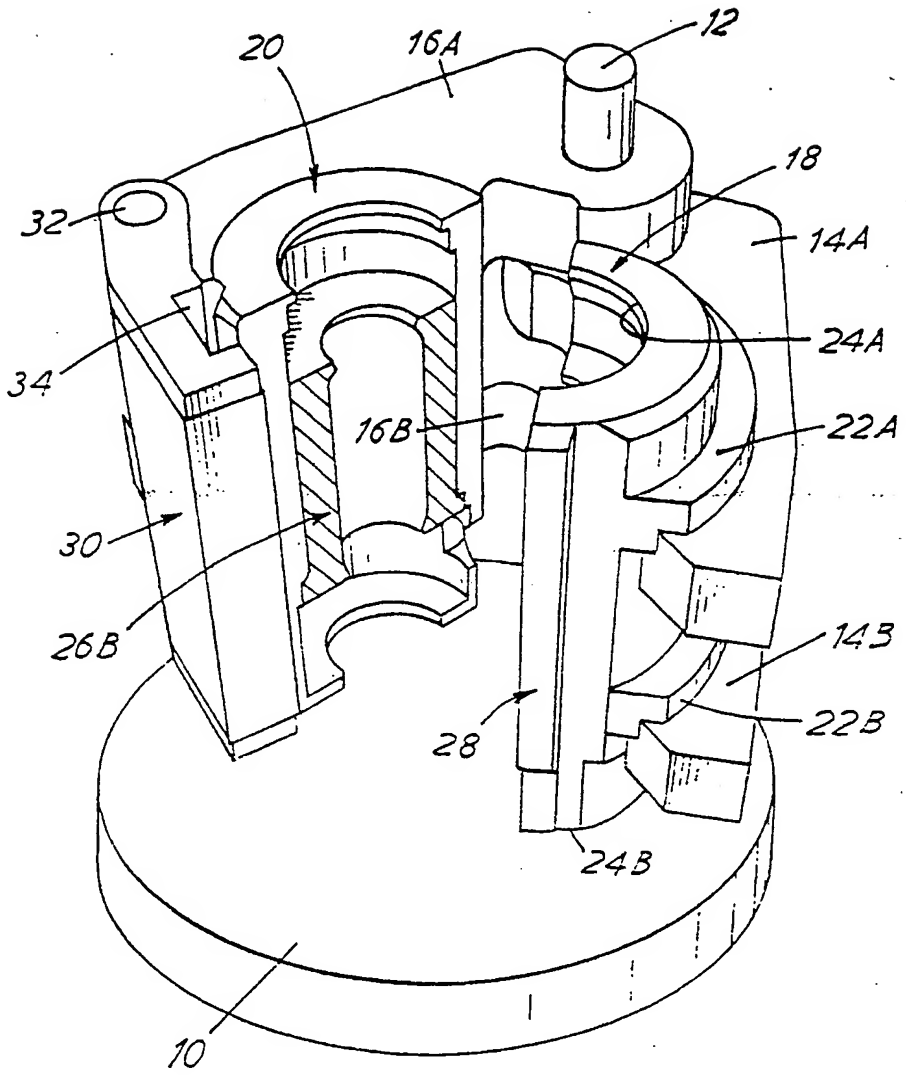

FIG. 6.

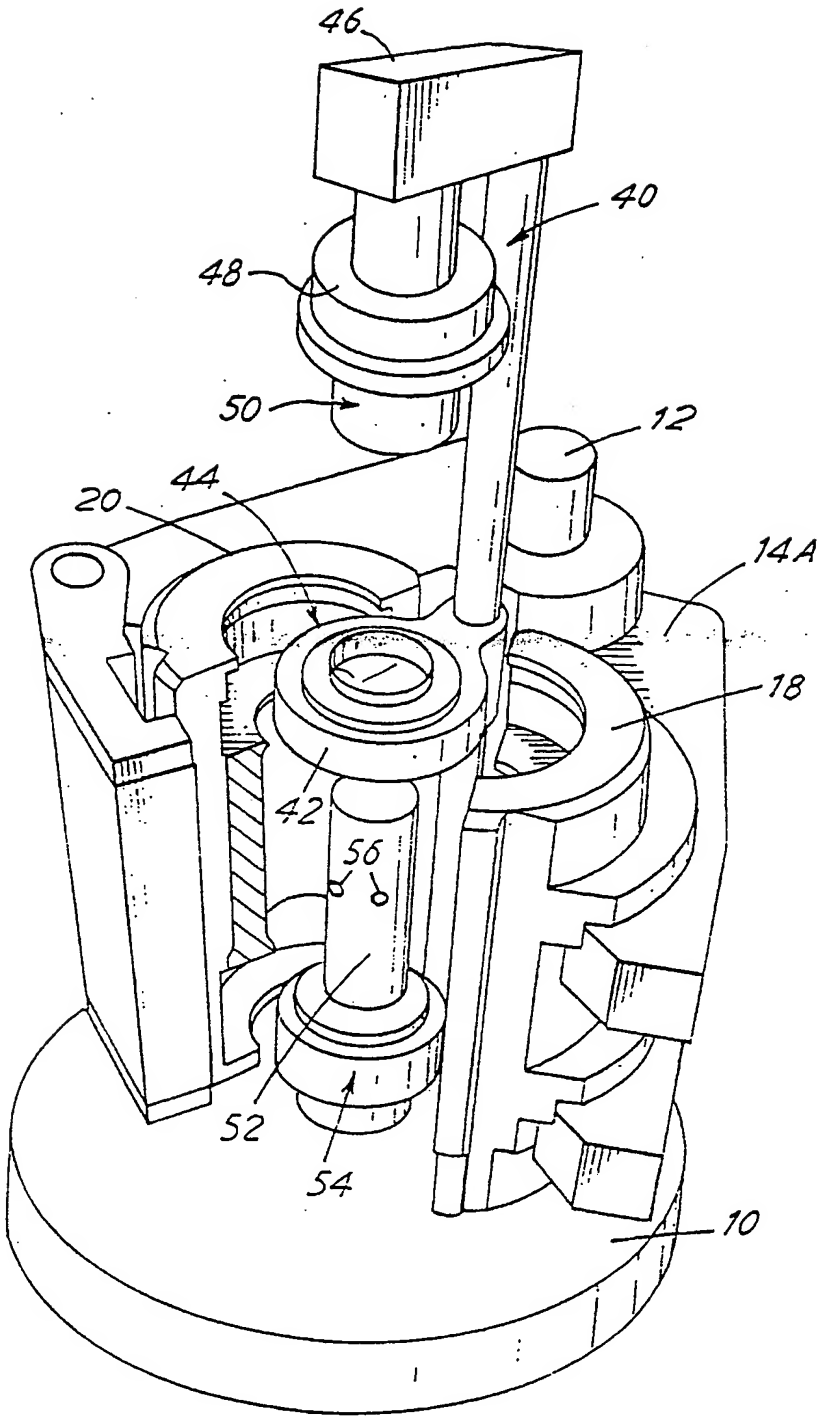

FIG.7

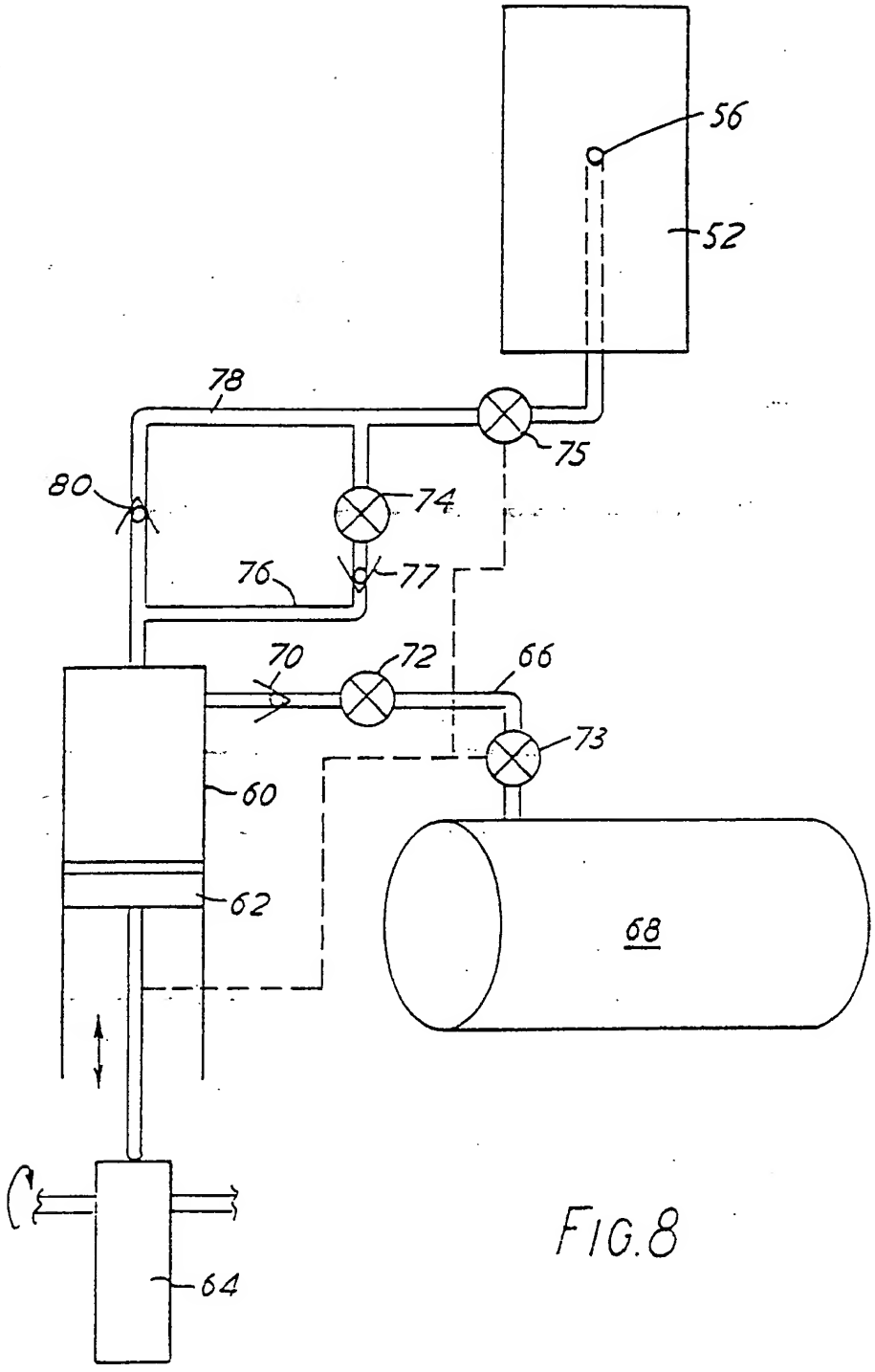

FIG. 8

PNEUMATIC RESHAPING OF CONTAINERS

The present invention relates to the pneumatic reshaping of containers.

It has been previously proposed to place a metal can in a mould of predetermined shape and to pump liquid under pressure into the can to cause the can to expand within the mould until it takes on the predetermined shape of the mould.

It has also been proposed to fill the can with an explosive gas instead of liquid and to ignite the mixture so that the explosive forces again cause the can to adopt the predetermined configuration of the mould.

Both these methods tend to contaminate the inner surface of the can which must then be cleaned before being processed further.

US Patent No. 3 224 239 discloses a method of reshaping a hollow metal can in which a can is placed in a mould and a piston and cylinder is coupled to the open end of the can. The piston is operated to enter the can and so compress the air within the can. The air pressure builds up to a degree such that the can will expand to conform to the shape of the mould. The arrangement is cumbersome to operate since the can must be locked in sealing engagement with piston and cylinder, and properly aligned therewith to avoid the piston fouling the inner surface of the can as it enters the cylinder. Also for different can sizes the piston must be replaced with one which conforms is the new can size and the mechanism which controls the stroke of the piston must also be adjusted.

All this necessarily increases the size of the equipment and makes it difficult to operate on a mass production basis.

Furthermore, there is very little control over the air pressure introduced into the can since it is largely determined by the size and stroke of the piston. US Patent No. 3 224 239 does envisage a modification in which the air pressure in the can is supplemented by the air pressure produced by an auxiliary piston and by a precharge of air from a source of pressure.

With this arrangement, however, a large volume of air is used, necessitating an expenditure of a greater amount of energy - all of which is lost when the can is released from the mould.

The apparatus and method for pneumatically reshaping containers to be described can be used for a number of different purposes.

It can be used to increase the internal volume of a can from one standard size to the next. This can be done more cheaply with the apparatus described than by manufacturing the larger size can with thinner gauge material since the cost of producing thinner gauge material rises significantly, the thinner the material becomes, particularly for very thin sizes of material.

It can be used to provide the containner with an artistic shape pleasing to the eye or pleasing to hold. For example beer cans can be shaped to conform to beer glasses to simulate a waisted beer glass to those users who drink directly from the can.

It can be used to provide the can with circular or other ribs which may also work harden the can and so increase the can's resistance to crushing.

It can also be used to emboss, for example the logo of a particular manufacturer, on the can.

It is an object of the present invention to provide an improved method and apparatus for reshaping containers.

According to the present invention there is provided a method of reshaping a hollow member having a flange around an opening therein the method comprising the steps of placing the member inside a mould of predetermined internal profile, clamping the flange to the mould, inserting a solid into the member to leave a gap between the solid and the wall of the member to be reshaped, injecting a compressible fluid under pressure into the said gap to cause the wall of the member to be reshaped to conform to the shape of the corresponding portion of the mould, recovering and conserving some of the fluid while still under pressure from the container for use in pressurising a subsequent container, the pressurisation of the fluid being accomplished totally outside the container.

According to the present invention there is further provided apparatus for reshaping a hollow container having a flange around an opening therein, the apparatus comprising a mould defining a chamber to accommodate the container, clamping means for clamping the flange of the container to with the mould, a mandrel located in the chamber to substantially fill the container when clamped to the mould, and a piston and cylinder arrangement having a cylinder coupled to supply air to the chamber through the mandrel and operable to fill the gap between the mandrel and the container when clamped to the mould, with compressible fluid under pressure, the pressure of the fluid being of sufficient magnitude to cause the container to expand into conformity with the mould.

A method and apparatus for reshaping containers will now be described, by way of example, with reference to the accompanying diagrammatic drawings in which:

Figures 1A and 1B are front elevations of a first example of a can respectively before and after reshaping;

Figures 2A and 2B are front elevations of a second example of a can, respectively before and after reshaping;

Figures 3A and 3B are front elevations of a third example of a can, respectively before and after reshaping;

Figure 4 is a front elevation of a further example of a can after reshaping;

Figure 5 is a plan view of an automated can reshaping system;

Figure 6 is a fragmentary perspective view of one can reshaping apparatus of the system;

Figure 7 is a perspective view of the apparatus of Figure 6 in more detail;

Figure 8 of the pneumatic control system of the apparatus of Figures 6 and 7.

The containers to be reshaped by the method and apparatus described hereinafter, are basically two piece metal cans comprising a cylindrical body portion open only at one end and encircled at the open end by a flange, and lid which will eventually be secured to the flange of the body portion. Three piece metal cans can also be used after closure at the other end by another lid.

The cans are preferably coated internally with a stretchable lacquer and externally with stretchable paint so that the lacquer and paint are not damaged by the reshaping process.

Figures 1A, 2A and 3A show three different cans prior to reshaping and Figures 1B, 2B and 3B show the same three cans after reshaping by the method and apparatus embodying the invention.

Figure 4 shows another fancy shape of can which can be achieved with the apparatus and method embodying the invention.

The apparatus shown in Figure 5 comprises a rotary turntable 2 on which are mounted, for example, eight circumferentially spaced can reshaping stations 4. As the turntable 2 rotates each station 4 passes a can dispensing station 6 (which may be a starwheel feed arrangement) where it receives a can, open at one end. As the turntable 2 continues to rotate, the can is processed until the station 4 reaches a discharge station 8 at which point the can is discharged. Thereafter the reshaping station travels past the can dispensing station 6 to receive the next can for processing.

Each can reshaping station 2 is identical and so only one will be described hereinafter.

As shown in Figure 6 the station comprises a base 10 supporting an upstanding pivot pin or post 12. Pivotally supported on the pivot post 12 are a first pair of hanger arms 14A and 14B and a second pair of hanger arms 16A and 16B.

The two pairs of hanger arms 14A,14B and 16A,16B respectively support a pair of mould halves 18 and 20 for a clam-shell like opening and closing operation.

The mould half 18 is semi cylindrical in shape and has two circumferentially extending axially spaced ribs 22A and 22B on its external surface which are engaged by respective ones of the two hanger arms 14A and 14B. The mould half 18 is thus pivotally

supported on the pivot pin 12 by the hanger arms 14A and 14B. The mold half 18 has two semi-circular radially inwardly directed flanges 24A and24B at opposite axial ends (similar flanges can be better seen on the other mould half 20). The inner face of mould half 18 has a stepped profile to receive a corresponding half 26A of a mould liner 26. This can be better seen from the other half 26B of the mould liner received in the other mould half 20. Along the axially extending edge of the mould half 18 remote from the pivot pin 12, is a radially outwardly directed rib 28.

The mould half 20 is of similar construction to the mould half 18 and the two mould halves 18 and 20 can be moved together by their respective hanger arms to form a generally cylindrical mould. The mould liner has an internal profile which corresponds to the ultimate shape of the cans after reshaping.

A locking block 30 is pivotally supported at the distant ends of the hanger arms 16A and 16B by means of a pivot pin 32. The locking block 34 has an axially extending slot 34 which extends parallel to both pivot pins 30 and 32 with compliance to allow for the radial swing of the arms.

In operation when the two pairs of hanger arms 14A,14B and 16A,16B are pivoted to bring the two mould halfs 18 and 20 together, the two radially outwardly extending ribs 28 on the halves are brought into side-by-side contact so that if the locking block 30 is now pivoted towards the ribs 28, the ribs will engage the slot 34 and so the two mould halves will be locked together. Either the side walls of the slot 34 or the surfaces of the ribs which they engage or both, are preferably slightly tapered to

ensure that the two ribs 28 are progressively locked more tightly together during the final stages of movement of the locking block 30 onto the ribs 28.

When the two halves of the mould are locked together there is a channel defined between the two pairs of the hanger arms 14A,14B and 16A,16B and the two mould halves 18 and 20 at a location adjacent the pivot pin 12 to accomodate the shaft of a loading shuttle to be described in more detail hereinafter.

The movement of the hanger arms and the locking block is controlled by a cam mechanism (not shown) coupled to the turntable drive system so that the movement of the various components is co-ordinated according to the angular position of the station 4 on the turntable.

Figure 7 shows the reshaping station 4 incorporating the can loading shuttle for loading a metal can into the mould. Each can is received by the shuttle in an inverted state, i.e. with the open end at the bottom and the closed end at the top.

The shuttle comprises a shaft 40 which is upstanding from the base 10 and which is slidable through the base 10. The shaft 40 is shown in its raised state and supports at an intermediate location an annular base support 42 having an annular recess which loosely carries a base ring 44 having its upper surface profiled to correspond to the flange at the open end of the can which it will eventually receive.

The upper end of the shaft 40 carrier a head 46 which supports a circular closure flange 48. On the underside of the closure flange 48 lies an insert 50 shaped to conform to the closed end of the can.

Supported on the base 10 is a cylindrical

mandrel 52 which is arranged to lie in the middle of the chamber defined by the two mould halves 18 and 20 when closed. Encircling the mandrel 52 and held above the base 10 by a spring (not shown) is a hydraulic clamp 54. The mandrel 52 has a central channel, supplied by a source of pressure (not shown) which communicates with opening 56 in its surface.

In operation when the reshaping station 4 lies opposite the can dispensing station 6, the shuttle is in the raised state (as shown in Figure 7) and the two mold halves 18 and 20 are open wide.

A can is then dispensed from the dispensing station into the gap between the insert 50 and the base ring 44 with the flange of the can mating with the corresponding surface of the base ring 44. The shaft 40 is then lowered down wardly to clamp the can between the insert 50 and base ring 44 and thereafter draws the can into the space between the mould halves 18 and 20. The can passes over the mandrel 52 wit a small clearance. The base support 42 eventually comes to rest on the hydraulic clamp.

At this point the hanger arms 14A,14B and 16A,16B are pivoted about the shaft 12 to bring the two mould halves together whereupon the locking block 30 is pivoted to lock the two halves together.

In this operation the column of components comprising the hydraulic clamp, the base support 42, the base ring 44, the can, the insert 50 and the closure flange are all locked inside the mould between the two radially inwardly directed end flanges 24A and 24B. This provides a safety containment zone for the processes which follow.

The hydraulic clamp 54 is then operated (by means not shown) to expand axially. This pushes the base ring 44 upwardly to clamp the flange of the can

against a correspondingly profiled portion of the mould liner 26. As the clamp 54 continues to expand it moves towards the base 10 against the bias of the intervening spring until it engages the radially inwardly directed flange 24B whereupon the flange of the can is tightly and securely held to resist any deformation. Because the ring 44 floats loosely on the base support 42 this ensures correct centering of the can with respect to the mould insert during clamping.

Air pressure is now supplied to the mandrel 52 which exits through the holes 56 to fill the narrow cylindrical space between mandrel 52 and the can with high pressure air. This forces the walls of the can to conform to the profile of the mold insert 26.

Pressure is partially released inside the can, the locking block 30 is opened, the two mould halves are moved apart, and the shuttle shaft 20 is raised to withdraw the can from the mould. As soon as the reshaping station reaches the discharge station 8 the can is presented to the discharge station 8 and the can discharged. When the apparatus reaches the dispensing station the process is repeated.

The pneumatic system for supplying air under pressure to the mandrel 52 is shown in Figure 8.

A cylinder 60 has a piston 62 operated by a rotary cam 64 which is coupled to the drive system of the turntable by means (not shown). At or before the start of the forward stroke of the piston 62, the chamber of the cylinder 60 is precharged with air from a line 66 connected to a source 68 of substantially constant pressure. The line 66 has a

one way valve 70 so that air can only flow in one direction namely from the source 68 to the chamber of the cylinder 60, and a pressure relief valve 72 which only allows the flow of air when the pressure difference exceeds a first predetermined valve (say 20 bar).

The output line 76 from the chamber feeds the opening 56 in the mandrel. The line 76 contains a one way valve 77 and a pressure relief valve 74 which allows the flow of air as soon as the pressure difference exceeds a second predetermined value (say 25 bar). A bypass line 78 containing a one way valve 80 is connected across the valve 74 to allow air to flow only from the opening 56 back to the cylinder 60.

In operation when the can is securely clamped in the mold and is ready for reshaping, the cam 64 operates the piston 62 to perform its forward stroke very rapidly. As soon as the pressure in the cylinder exceeds the second predetermined value, the valve 74 will crack to release air to the mandrel. The air pressure continues to build up until the piston completes its forward stroke. At this time the can will have been subjected to substantially uniform pressure of say 30 to 60 bar to cause it to take up the shape of the mould insert 26. The air will have been compressed substantially adiabatically and this will add to the level of air pressure produced.

At the end of the forward stroke, the piston 62 will immediately start its return stroke and withdraw some of the air under very high pressure from the can through the one way valve 80. As the size of the chamber in the cylinder 60 increases, then pressure will drop until just before the end of

the stroke the pressure falls below the first predetermined value. The valve 72 will crack open to admit a precharge of air from the source 68 and the valve 80 will immediately close.

At this point the can will be exhausted, the mould will be opened and the can removed in the manner hereinbefore described.

It will be appreciated that with the pneumatic system described some of the energy in reshaping the can is conserved so that it can be topped up and used again for the next can to be reshaped.

In a modification timed ON/OFF valves 73 and 75 are respectively inserted into lines 66 and 78.

These valves 73 and 75 are coupled to the piston 62 so that the valve 73 is turned OFF and the valve 75 turned ON just before the piston 62 reaches the end of its return stroke, and the valve 73 is turned OFF and the valve 75 turned ON just after the piston 62 starts its forward stroke.

This arrangement ensures that the maximum amount of air is withdrawn from the can before the cylinder receives its precharge of air from the source 68.

The hydraulic system for operating the hydraulic clamp may be a simple cam driven pneumatic to hydraulic conversion piston and cylinder arrangement driven by the turntable drive system.

With the pneumatic arrangement described the size of the piston can be kept small (much smaller than the diameter of the can) and this reduces the force needed to move the piston.

This together with the mandrel located inside the can reduces the total volume of air which

needs to be compressed and thus enables a significant saving in overall size of the apparatus and the running costs to be achieved.

While the pneumatic arrangement uses air as the gas for filling the container it will be appreciated that other gases such as nitrogen can be used instead.

In a modification the locking means for locking the mould halves together may comprise a pair of parallel ribs on said locking blocks engaging corresponding ones of a pair of slots in the external surface of said mould halves.

With seamed cans where the seams result in a local thickening of the flange it may be necessary to provide the base ring and/or the mould liner with an indentation to accommodate this local thickening. In this event it will be necessary to provide means for ensuring the correct orientation of the can prior to being gripped by the shuttle mechanism.

CLAIMS

1. A method of reshaping a hollow member having a flange around an opening therein the method comprising the steps of placing the member inside a mould of predetermined internal profile, clamping the flange to the mould, inserting a solid into the member to leave a gap between the solid and the wall of the member to be reshaped, injecting a compressible fluid under pressure into the said gap to cause the wall of the member to be reshaped to conform to the shape of the corresponding portion of the mould, recovering and conserving some of the fluid while still under pressure from the container for use in pressurising a subsequent container, the pressurisation of the fluid being accomplished totally outside the container.

2. Apparatus for reshaping a hollow container having a flange around an opening therein, the apparatus comprising a mould defining a chamber to accommodate the container, clamping means for clamping the flange of the container to with the mould, a mandrel located in the chamber to substantially fill the container when clamped to the mould, and a piston and cylinder arrangement having a cylinder coupled to supply air to the chamber through the mandrel and operable to fill the gap between the mandrel and the container when clamped to the mould, with compressible fluid under pressure, the pressure of the fluid being of sufficient magnitude to cause the container to expand into conformity with the mould.

3. Apparatus according to Claim 2 including means for insulating the cylinder from the chamber during the return stroke of the piston when a predetermined amount of air pressure has been

recovered from the chamber and means for supplementing the pressure of the air in the cylinder before the forward stroke of the piston.

4. Apparatus according to Claim 2 or to Claim 3 wherein the mould comprises two complementary mating mould parts which, when mating, define said chamber having a predetermined axis and open at opposite axial ends, means mounting the mould parts for pivotal movement towards or away from one another about a pivot axis extending parallel to but spaced from the predetermined axis to close and open the chamber, the mounting means including locking means for locking the two mould parts together on a side of the predetermined axis remote from the pivotal axis, and wherein the clamping means comprises first and second axially spaced container constraining means arranged to be imprisoned by two mould parts when locked together, to close opposite axial ends of the chamber whereby to enable a said container to be securely imprisoned in said chamber.

5. Apparatus according to Claim 4 wherein said mounting means comprises two pairs of hanger arms pivotally supported on a common pivot post and supporting respective ones of said two mould parts, each said mould part having an external rib thereon extending parallel to said axis and located on a side thereof remote to said pivot post and wherein said locking means comprises a locking block pivotally supported at the distal end of one pair of said hanger arms for pivotal movement about an axis parallel to said predetermined axis, said locking block having an axially ending slot for engaging the two said ribs when the mould parts mate to prevent the mould parts from opening.

6. Apparatus according to Claim 5 wherein the

engaging surfaces of one of said pair or ribs or said slot are tapered so as to urge the mould parts closer together as the slot progressively engages the ribs.

7. Apparatus according to Claims 4 to 6 wherein each said constraining means are generally disc like and wherein said chamber has radially inwardly directed flanges at opposite end portions having an internal diameter smaller than external diameter of the constraining means whereby to provide the imprisoning action of the chamber on the constraining means.

8. Apparatus according to any one of Claims 4 to 7 wherein said first constraining means is profiled to substantially mate with the surface of the closed end of said container.

9. Apparatus according to any one of Claims 4 to 8 wherein the second constraining means is arranged to engage the open end of said container and supports an annular member having a profile which mates with the flange of the container and is capable of limited movement radially of the predetermined axis.

10. Apparatus according to Claim 9 wherein said second constraining means includes a clamping member capable of expansion to cause the annular member to urge the flange of the container into clamping engagement with a mating portion of the mould defined by the mould halves.

11. Apparatus according to any one of Claims 4 to 10 wherein said first and second constraining means are mounted on a shaft extending parallel to said predetermined axis and means for displacing said shaft axially to move the constraining means axially of said predetermined axis to load and discharge a container into the space between the two mould halves

when said chamber is open.

12. Apparatus according to Claim 11 wherein the axis of said shaft is located between the predetermined axis and the pivotal axis.

13. Apparatus according to any one of Claims 4 to 12 including means for supplying compressible fluid to said chamber when closed to expand any container in said chamber into conformity with said mould.

14. Apparatus according to any one of Claims 4 to 13 wherein said mould halves include mould liner inserts defining the profile of the desired shape of the container.

15. Apparatus for reshaping a hollow member substantially as hereinbefore described with reference to the accompanying drawings.

16. A container produced by the method or apparatus of any preceeding claim.

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